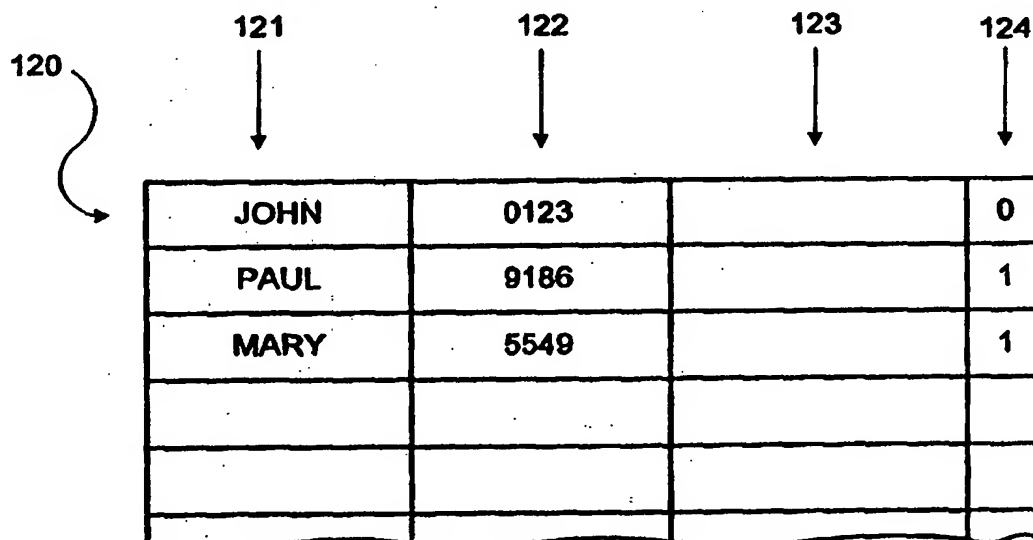




INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : G07C 9/00, H04M 3/38		A1	(11) International Publication Number: WO 98/16906
			(43) International Publication Date: 23 April 1998 (23.04.98)
(21) International Application Number: PCT/EP96/04480 (22) International Filing Date: 15 October 1996 (15.10.96) (71) Applicant (for all designated States except US): TELECOM PTT [CH/CH]; Forschung + Entwicklung, Ostermundigenstrasse 93, CH-3000 Berne 29 (CH). (72) Inventors; and (75) Inventors/Applicants (for US only): MOSER, Thomas [CH/CH]; Quellenweg 9, CH-8224 Löhningen (CH). VAN KOMMER, Robert [NL/CH]; Route du Coteau 45, CH-1752 Villars-sur-Glâne (CH). (74) Agent: BOVARD LTD.; Optingenstrasse 16, CH-3000 Berne 25 (CH).		(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, ARIPO patent (KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG). Published <i>With international search report.</i>	

(54) Title: **SPEAKER VERIFICATION METHOD**

(57) Abstract

Method for enabling a user of a system to obtain access to one or more services, for example for enabling a caller to access some information on a remote server. The method comprises the following steps: the system first prompts the caller to identify himself by entering a subscriber code (121). A speaker verification is then made using a voice comparison between the caller's voice and a voice reference (123) associated with the subscriber the caller claims to be. Access to the requested services is given if the outcome of said voice comparison is positive; if the system does not store a sufficiently good voice reference to verify the identity of the subscriber the user claim to be with a predetermined degree of reliability, the caller is prompted to enter a confidential PIN code (122). If the PIN code entered is correct, access to the requested services is given and a new voice reference is stored.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LI	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

Speaker Verification Method

The invention relates to a method for enabling a user of a system to obtain access to one or more services according to the preamble of claim 1.

In many situations, it is necessary to identify users before giving
5 them access to services or systems. These services include remote access to computers, electronic banking transactions, security access control for buildings, etc. In the same way, for many new telephone services it is necessary to verify unambiguously the identity of the caller. The caller identity usually cannot
10 be determined from the access point in the telephone network used by the caller, as a caller may want to access those services from different access points.

An object of the present invention is to provide a method for enabling a user of a system to be identified and thus to obtain access to one or more services in a convenient way.

15 In a well-known method used for identifying a user in a system, the user is first requested to identify himself by entering a personal identification code (ID). The user is then requested to enter a secret password used to verify the claimed identity. Access to the requested services is given only if the entered password matches the entered ID. This is the method, for example, for
20 using the calling cards proposed by many different telephone network operators. A subscriber who wants to use the service is usually furnished with a card, for example in credit card format, on which a subscriber code or number is printed. Furthermore, the subscriber is given a confidential personal identification code (PIN code) he has to remember. The subscriber code is needed for
25 identifying the subscriber and the PIN code for verifying the entered identity.

To use the service, the subscriber calls a toll-free telephone number which connects him to the server which implements the calling card service. Once the call setup has been established, a speech generator in the server prompts the caller to enter first his subscriber number (which is printed on the
30 card he has previously bought), and then his confidential PIN code. Those

CONFIRMATION COPY

numbers may be entered manually on the telephone keyboard or, more comfortably, orally. In this latter case, the digits are recognized by a speech recognizing algorithm implemented in the server.

If the server recognizes the subscriber number entered and if the entered PIN code matches this subscriber number, the subscriber can then be
5 connected to another subscriber within the network. The invoice for the telephone call will be sent automatically to the calling subscriber, independently of the place from which the call was made.

This method is very tedious for the subscriber who has to enter successively two numbers, one of which has to be memorized. The security is not
10 optimal, as very often the PIN code is written down near or on the card.

The U.S. Patent No. 5,297,194 describes a method in which the subscriber is prompted to enter one unique password digit-by-digit. A speech recognition algorithm running on the digital processing system of the server
15 processes the information received and, using a statistical recognition strategy, determines the digits. After all digits have been recognized, and if the password is valid, the server uses a speaker verification algorithm to determine if the entered password has been spoken by a caller whose voice has been previously assigned to the password. Access to other services is allowed only if the
20 verification algorithm establishes a match; otherwise, the system rejects the access inquiry and the call is terminated.

This method generally requires the subscribers to have previously enrolled in the system. Accordingly, the speaker verification algorithm uses a voice reference database comprising voice references collected from all
25 authorized subscribers. Enrollment is accomplished by having the subscriber repeat a multidigit password several times. A voice reference is then obtained from those utterances. This voice reference is assigned to the password attributed to the subscriber.

This method requires active collaboration of the user at the time of
30 enrollment and thus discourages in particular new subscribers. Moreover en-

rollment is generally carried out in a single session from a single telephone apparatus, for example from the telephone at the address of the new subscriber. The quality of the voice reference registered therefore very much depends upon the characteristics of the telephone apparatus originally used, and the subscriber risks not being recognized if he later calls from a different telephone.

Other speaker recognition methods and algorithms are described by George R. Doddington in "Speaker Recognition - Identifying People by their Voices", Proceedings of the IEEE, vol. 73, No. 11, Nov. 1985, pp. 1651-1664; by John Oglesby in "What's in a number? Moving beyond the equal error rate", Speech Communication, vol. 17, 1995, pp. 193-208; and by Sadaoki Furui, in "An overview of Speaker Recognition Technology", ESCA Workshop on Automatic Speaker Recognition, Identification and Verification.

The object of the present invention is to provide an improved method for enabling a user of a system to obtain access to one or more services.

This object is attained according to the invention by means of supplementary steps as set forth in the characterizing part of claim 1.

Preferred embodiments of the invention follow from the dependent claims.

According to the invention, a subscriber receives a subscriber code and a confidential PIN code, as in the prior art. The subscriber code serves to identify the subscriber and the PIN code to verify the claimed identity.

To use the service, the user is first prompted (for example by a speech generator) to enter his subscriber code. This number may, for example, be printed on a subscriber card he has previously bought. A speaker verification algorithm is then used for verifying the identity claimed by the user by making a voice comparison between the user's voice and a voice reference stored in the system and associated with the subscriber code entered by the user. Access to the requested services is given if the user's voice matches said voice reference.

If said voice reference is not good enough to verify the claimed identity with a prescribed degree of reliability, the user is then prompted to enter his confidential PIN code. The PIN code is then checked, and, if the outcome of this check is positive, a new voice reference is created in a background process
5 and associated with the subscriber code entered by the user.

One advantage of the invention, especially if used for identifying callers in a telephone network, is that the voice reference is created and stored during several sessions, usually from different locations and with various telephone apparatus. Thus, the voice reference stored for a given subscriber
10 usually takes very different environmental conditions (noise, telephone lines, microphone, etc.) into account.

According to the invention, a specific enrollment session is not needed. Therefore, the method is very user-friendly, especially for new subscribers.

15 In the same way, the voice reference created takes into account possible user speech variations between two sessions. For example, it happens often that the user's voice is less sure and quick during the first session than during subsequent ones, when the user feels more confident.

It is possible to use a very high number of utterances for the voice
20 reference without making the procedure too uncomfortable for the user. Even if the voice reference is already sufficiently good for a reliable verification of the user's identity, it is still possible to take new utterances into account in order to improve even more the quality of the voice reference and to adapt it to the user's voice variations.

25 An embodiment of the invention is described below, by way of example only, and illustrated by the figures which show:

Figure 1 is a flow chart of this embodiment,

Figure 2 is a partial flow chart of the steps undertaken by the server when it has not stored sufficient reference voice parameters to recognize the subscriber with sufficient security,

Figure 3 is a partial flow chart of the steps undertaken by the server when it has already stored sufficiently good reference voice parameters to recognize the subscriber with a prescribed degree of reliability,

Figure 4 shows the structure of a database set up according to the method of the present invention.

Before the different steps of the method according to the invention are explained in detail, a database 120, used for implementing the method according to the invention, will be described, with reference to Figure 4. Each record of the subscriber database corresponds to one subscriber and contains all information needed to identify and verify the identity of the user. The associated record for each subscriber includes a subscriber code field 121, a PIN code field 122, a voice reference field 123 and a reference flag 124. The subscriber code field 121 includes enough digits to designate unambiguously each subscriber. In this example, the subscriber code field includes alphanumerical digits; however, in many applications, only numbers will be allowed. PIN code field 122 includes enough digits to verify the claimed identity of the user with a prescribed degree of reliability which may depend on the application. Again, digits can be either alphanumerical or just numerical. The voice reference field 123 stores a voice reference corresponding to the subscriber. Depending on the speaker verification algorithm used, the voice reference field may store several samples of the voice (utterances) of the subscriber, one sample extracted from one or several utterances, or one or several parameters extracted from one or several previous utterances of the subscriber. Reference flag 124 is a single bit indicating if the voice reference stored in field 123 is of sufficiently good quality to verify the identity of the subscriber with the prescribed degree of reliability.

The method used by the system will now be explained with reference to Figures 1 to 3, which relate more particularly to caller identification in a telephone network.

A user wishing access to the services offered calls the server implementing the method of the present invention (step 2). During step 4, the user is first greeted and then prompted to enter his subscriber code (or some other form of identification data).

Preferably, the subscriber code is entered orally, for example sequentially and digit-by-digit. Alternatively, the subscriber code may be entered manually with a keyboard, for example on the user's receiver. In this latter case, the user will be prompted to say something, for example to repeat a standard sentence.

The next step 6 consists in subscriber identification. If the subscriber code is entered orally, subscriber identification implies speech recognition to extract the subscriber code from the sentence spoken by the user. If the subscriber code is entered manually using the keyboard on the receiver, the generated pulses or tones are used to determine the digits of the subscriber code. Steps 4 and 6 could possibly be repeated several times until the transmission quality is sufficiently good for identifying the subscriber code. As a different subscriber code is assigned to each different subscriber, after step 6 the system knows the identity claimed by the user.

A test is made during step 8 to check if a voice reference 123 has already been assigned in database 120 to the subscriber the user claims to be. If the outcome of this test is negative, phase A is executed, described below in connection with Figure 2. On the other hand, if a voice reference 123 has already been assigned to the identified subscriber, the reference flag 124 is checked during step 10. We will see below that this flag is set to 1 if, and only if, the voice reference 123 assigned to the subscriber is sufficiently good (depending on the algorithm used) in order to verify his identity with the desired degree of reliability.

If the reference flag 124 was at 0, phase A, discussed below in relation to figure 2, is executed (step 20); on the other hand, if it was set to a positive value, phase B, discussed below in relation to figure 3, is executed (step 30).

5 The reference flag 124 can also be set to 0 each time a new subscriber is stored in the database. In this case, it is possible to bypass the test 8.

Phase A will now be described in relation to figure 2. Phase A is executed when no voice reference 123 has been assigned to the subscriber in the database 120, or when the voice reference stored is not sufficiently good to
10 verify the identity of the subscriber with the prescribed degree of reliability. After a few calls, the identity of the subscriber will be verified automatically from the subscriber's voice, and this phase will no longer be executed.

At beginning of phase A, during step 21, the user is prompted to enter his PIN code. This PIN code is confidential; it can either be entered orally
15 or preferably manually using the keyboard on the receiver. In the first case, a speech recognition algorithm is used to recognize the orally entered PIN code; in the second case, the PIN code is determined from selection pulses or tones generated manually with the keyboard. During step 22, a verification is made to check if the PIN code entered by the user matches the PIN code 122 assigned
20 to the subscriber the user claims to be. If the PIN code is wrong, access to services is denied and the call is terminated (step 23). In a variant embodiment, the user may have a second or even a third chance to re-enter his PIN code if the first try failed.

On the other hand, if the PIN code is correct, access is given to the
25 requested service (step 25). Depending on the application, the service can be connection with another network subscriber, access to a database, electronic funds transfer, credit card validation, subscriber personal identification, invoicing of the call on the user's account with the network provider, etc. However, it should be noted that the invention is not limited to these applications, which are
30 given as examples only.

In a background process (step 24), and simultaneously with step 25, a new voice reference is created using the user's voice sample (utterance) and assigned to the subscriber (field 123). Step 26 is a test to check if the voice reference created is now sufficiently good to verify the subscriber with the prescribed degree of reliability. What is meant by "sufficiently good" depends on the algorithm used for voice verification; the prescribed degree of reliability obviously depends on the application. It is possible for instance to determine that the voice reference is sufficiently good if it has been created from a minimum number of utterances, for example ten. In this case, the voice reference associated with each user is regarded as good enough as soon as said user has had access to the system 10 times or more. Counting means are necessary which store in an additional field associated with each subscriber code 121 the number of accesses entered by this subscriber. Alternatively, it is possible according to the speaker verification algorithm used to determine directly from certain parameters of the voice reference 123 whether the latter is sufficiently good. In the case of a negative response, the reference flag 124 corresponding to the subscriber is set or kept at zero in the course of step 27. On the other hand, if the voice reference is now sufficient, the reference flag 124 is set to 1 in the course of step 28. In this case, at the time of subsequent calls of the subscriber, only the subscriber code is required, as a rule, and, instead of phase A, the system carries out phase B, which will now be discussed in relation to Figure 3.

Phase B is carried out for calls of subscribers for whom the voice is sufficiently known to permit a sufficiently reliable verification of identity. In the course of step 31, the subscriber identity claimed by the user is verified using a speaker verification algorithm. In so doing, a comparison is made between the user's voice utterance and the voice reference 123 assigned in the system to the claimed subscriber. Any algorithm for verification of a known person can be used, for example an algorithm such as is described in one of the aforementioned documents to verify whether the user's utterance matches the voice reference associated with the subscriber code 121 entered by the user.

If the outcome of this test (step 32) is alright, i.e. if the identity of the user has been verified, access is given to the requested services (step 35). If,

on the other hand, the entered voice cannot be matched substantially to the voice reference assigned to the claimed subscriber, access to the requested services is denied and the call is terminated (step 33). In a variant embodiment, phase A is executed, instead of step 33, when the user's identity cannot be
5 verified from his voice. In this case, as described above, the user is prompted to enter his PIN code.

In a preferred embodiment of the invention, the user's utterance is used to create a new voice reference 123 in a background step 34, even if the voice reference assigned to the subscriber is already sufficiently good. This
10 new voice reference is stored in field 123 associated with the subscriber code 121 entered by the user. In this way the system adapts progressively to variations in the voice of the subscriber owing to aging, seasonal temperature variations, different telephone apparatus, etc.

The above description relates in particular to use of the method in a
15 telephone network. It is clear, however, that the invention can also be applied to other types of transactions or networks. For example, the invention can also be used for the verification of identity in automatic teller machines or in access control devices.

Claims

1. Method for enabling a user of a system to obtain access to one or more services, comprising at least the following steps:

- prompting (4, 6) the user to identify himself with a subscriber code
5 (121);

-subscriber verification (31,32) during which the user's voice is compared with a voice reference (123) associated with the subscriber code (121) entered by the user, access to the requested services being given if the user's voice matches said voice reference;

10 characterized by following supplementary steps undertaken when the voice reference (123) associated with the subscriber code (121) entered by the user is not sufficiently good to verify the subscriber's identity with a predetermined degree of reliability:

-prompting said user (21) to enter a PIN code (122);

15 -comparing (22) said PIN code entered by the user with a PIN code (122) associated with the subscriber code (121) entered by the user,

-if the PIN code entered by the user matches the PIN code (122) associated with the subscriber code (121) entered by the user, giving access (25) to the requested services and creating (24) a new voice reference (123) which
20 is associated with the subscriber code (121) entered by the user.

2. Method according to claim 1, in which the user is prompted to enter his subscriber code (121) orally, a speech recognition algorithm being used to recognize the subscriber code entered.

3. Method according to claim 1, in which the user is prompted to
25 enter his subscriber code (121) on a keyboard, tones or pulses generated by

typing the keyboard being used to recognize the subscriber code, and in which the user is prompted to speak a sentence allowing speaker verification.

4. Method according to one of the preceding claims, in which the user is prompted to enter his PIN code (122) when the user's voice does not
5 match said voice reference (123) associated with the subscriber code (121) entered by the user, access to the requested services being given if the PIN code entered by the user matches the PIN code (122) associated with the subscriber code (121) entered by the user.

5. Method according to one of the preceding claims, in which the
10 user is prompted to enter his PIN code (122) orally, a speech recognition algorithm being used to recognize the PIN code entered.

6. Method according to one of the preceding claims, in which the user is prompted to enter his PIN code (122) on a keyboard, tones or pulses generated by typing the keyboard being used to recognize the subscriber code
15 entered.

7. Method according to one of the preceding claims, in which a new voice reference (123) is created (34) and associated with the subscriber code (121) entered by the user when the user's voice matches said voice reference (123) associated with the subscriber code (121) entered by the user.

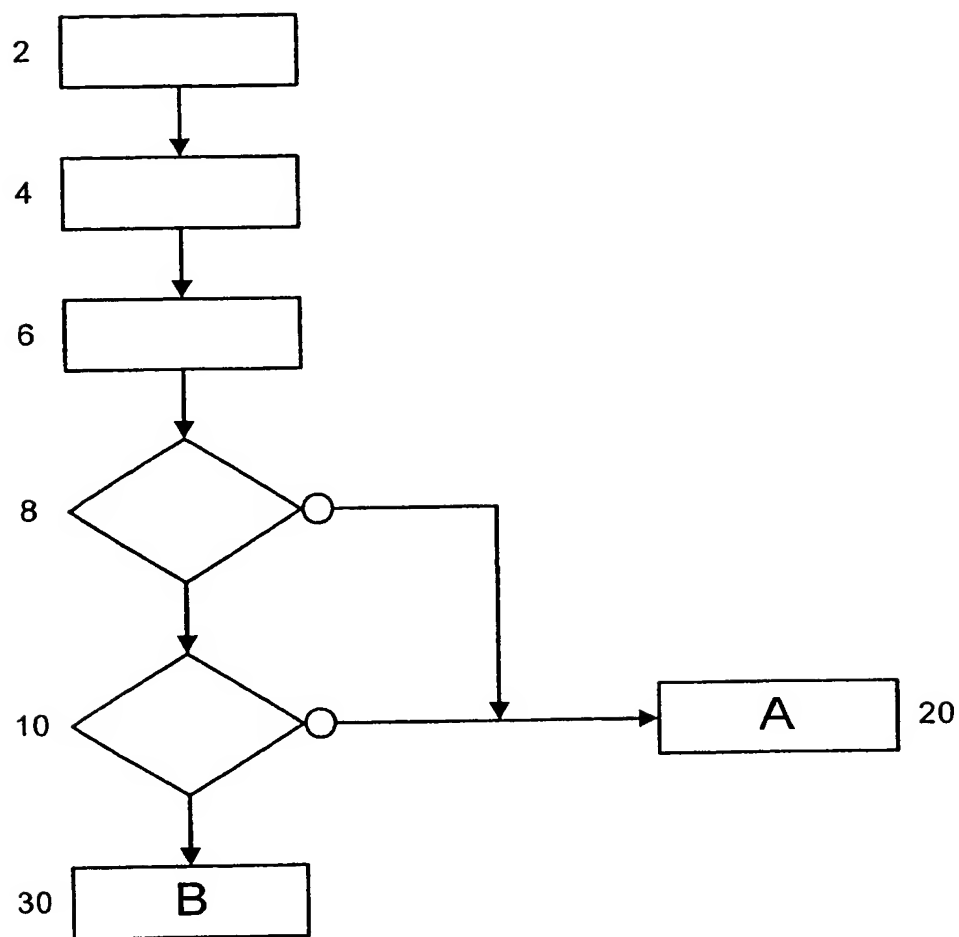


FIG. 1

2/3

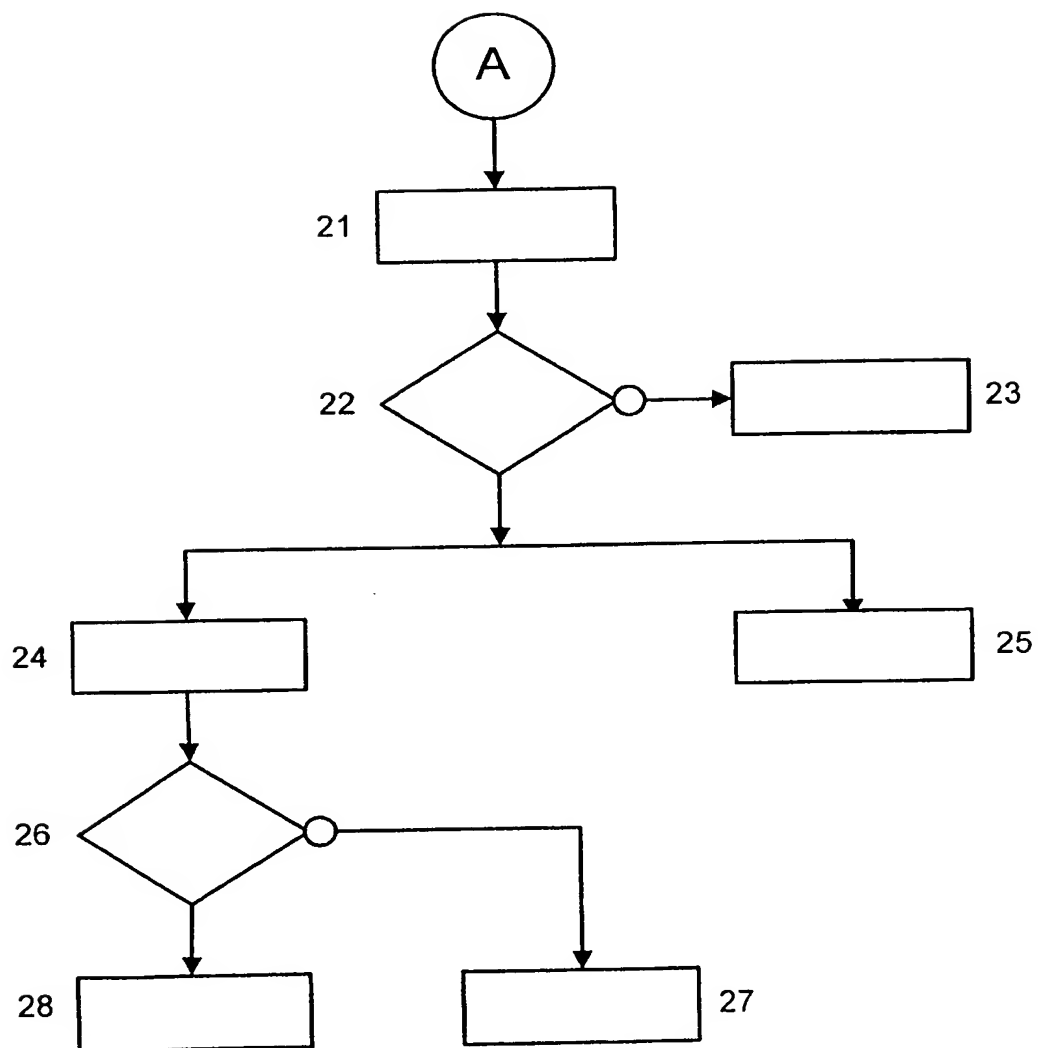


FIG. 2

3/3

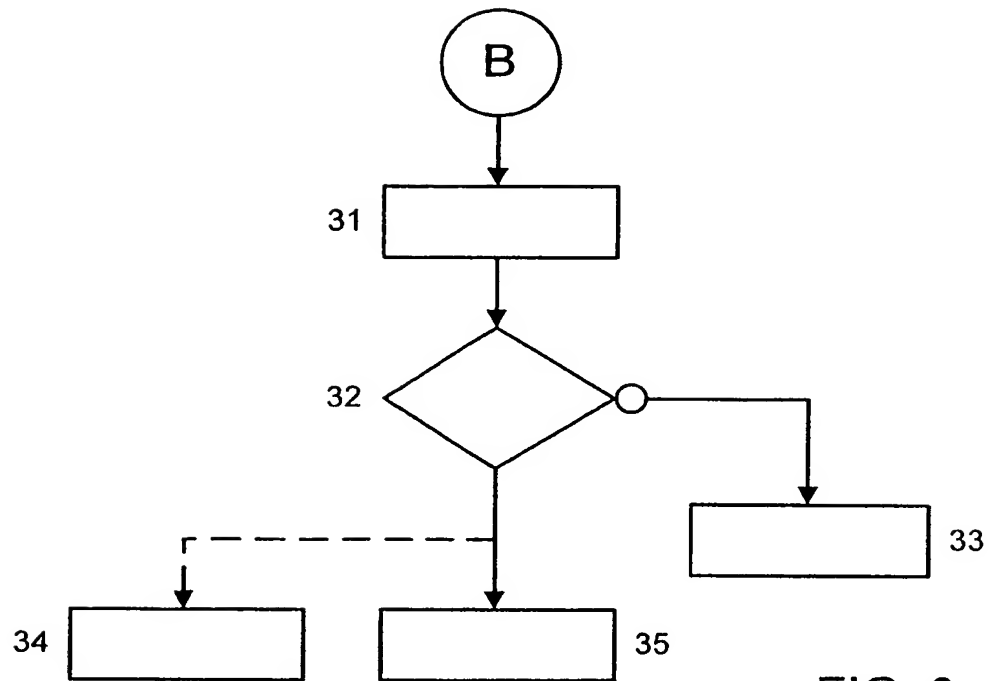


FIG. 3

120	121	122	123	124
	↓	↓	↓	↓
	JOHN	0123		0
	PAUL	9186		1
	MARY	5549		1

FIG. 4

INTERNATIONAL SEARCH REPORT

Inter. Application No
PCT/EP 96/04480

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 G07C9/00 H04M3/38

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 G07C H04M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5 297 194 A (HUNT ALAN K ET AL) 22 March 1994 cited in the application see column 1, line 55 - column 3, line 31 see column 5, line 66 - column 6, line 41; figures	1-7
Y	US 4 827 518 A (FEUSTEL TIMOTHY C ET AL) 2 May 1989 see column 1, line 34 - column 2, line 62; figures	1,2,4,5, 7

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

- *A* document defining the general state of the art which is not considered to be of particular relevance
- *E* earlier document but published on or after the international filing date
- *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the international filing date but later than the priority date claimed

- *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- *&* document member of the same patent family

Date of the actual completion of the international search

11 August 1997

Date of mailing of the international search report

28. 08. 97

Name and mailing address of the ISA
European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+ 31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+ 31-70) 340-3016

Authorized officer

Meyl, D

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 96/04480

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	AT&T TECHNICAL JOURNAL, vol. 65, no. 5, September 1986, pages 68-74, XP002037311 BIRNBAUM MARTHA: "A VOICE PASSWORD SYSTEM FOR ACCESS SECURITY" see page 68, column 2, line 19 - page 69, column 1, line 5 see page 72, column 1, line 30 - column 2, line 30 ---	3,6,7
A	WO 95 08821 A (VCS IND INC DOING BUSINESS AS) 30 March 1995 see page 2, line 8 - page 6, line 32; figures ---	1,2,4,5
A	WO 94 12973 A (VCS IND INC) 9 June 1994 see page 4, line 32 - page 6, line 2 see page 19, line 34 - page 20, line 35 see page 23, line 20 - line 34; figures ---	1,2,4,5
A	EP 0 454 363 A (AMERICAN TELEPHONE & TELEGRAPH) 30 October 1991 see column 2, line 29 - column 3, line 22 see column 4, line 19 - column 5, line 14; figures ---	1-6
A	SPEECH PROCESSING 1, GLASGOW, MAY 23 - 26, 1989, vol. 1, 23 May 1989, INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, pages 524-527, XP000089779 NAIK J M ET AL: "SPEAKER VERIFICATION OVER LONG DISTANCE TELEPHONE LINES" see page 525, column 2, line 27 - line 52 ---	1,7
A	US 5 274 695 A (GREEN JOHN E) 28 December 1993 -----	

INTERNATIONAL SEARCH REPORT

Information on patent family members

Int. onal Application No
PCT/EP 96/04480

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5297194 A	22-03-94	US 5127043 A	30-06-92
		US 5517558 A	14-05-96
		US 5499288 A	12-03-96
		US 5365574 A	15-11-94
		AU 649688 B	02-06-94
		AU 7995891 A	10-12-91
		CA 2082942 A	16-11-91
		EP 0528990 A	03-03-93
		WO 9118386 A	28-11-91
		US 5125022 A	23-06-92
		US 5303299 A	12-04-94
US 4827518 A	02-05-89	CA 1326299 A	18-01-94
WO 9508821 A	30-03-95	US 5517558 A	14-05-96
		AU 8011094 A	10-04-95
		CA 2172406 A	30-03-95
		EP 0746846 A	11-12-96
WO 9412973 A	09-06-94	US 5365574 A	15-11-94
		AU 676250 B	06-03-97
		AU 5677094 A	22-06-94
		CA 2150109 A	09-06-94
		EP 0671043 A	13-09-95
EP 0454363 A	30-10-91	CA 2040724 A	26-10-91
		JP 4229347 A	18-08-92
US 5274695 A	28-12-93	NONE	

This Page Blank (uspto)